

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF FLAGLER COUNTY, FLORIDA.

BY
ARTHUR E. TAYLOR.

W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]



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1922.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., June 24, 1921.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of Flagler County, Fla., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1918, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. H. C. WALLACE,
Secretary of Agriculture.

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MAP.

Soil map, Flagler County sheet, Florida.

SOIL SURVEY OF FLAGLER COUNTY, FLORIDA.

By ARTHUR E. TAYLOR.—Area Inspected by W. EDWARD HEARN.

DESCRIPTION OF THE AREA.

Flagler County lies in the northeastern part of Florida, about 50 miles southeast of Jacksonville. The Atlantic Ocean forms its eastern boundary and Crescent Lake a part of its western boundary. The county has an area of 491 square miles, or 314,240 acres.

The county may be separated into two main topographic divisions, the low-ridge region along the coast, and the flatwoods proper comprising the remainder of its area. The low-ridge region is in the northeastern part of the county, bordering the coast, and comprises a zone 3 to 5 miles wide, made up of low, narrow ridges, shallow valleys, and flatwoods. The shallow valleys and the low ridges, which in many cases are remnants of old beaches, extend in a northwest-southeast direction, parallel with the coast line. Immediately along the coast and separated from the mainland by the Florida East Coast Canal is the barrier island, which ranges from a few hundred yards to 1 mile in width. It consists mainly of a number of low, parallel, dunelike ridges with intervening troughs, but in places the surface is almost flat and more or less dotted with poorly drained basins.

The flatwoods proper consists of almost level areas interrupted by slight depressions, both large and small, in addition to shallow drainage ways and low, gently undulating ridges. Lake Diston occurs in the flatwoods region in the southwestern corner of the county and Gore Lake east of Bunnell. In the vicinity of Neoga there occur low sand dunes, small lakes, and limestone sinks.

The average elevation of the county, according to determinations made by the United States Geological Survey, railroad surveys, and drainage surveys, is about 24 feet. The elevations at some of the

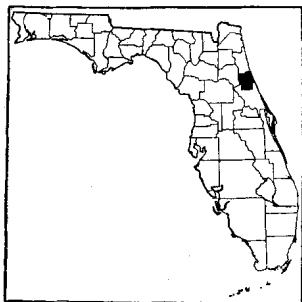


FIG. 1.—Sketch map showing location of the Flagler County area, Florida.

railroad stations are as follows: Roy 23 feet, Bunnell 21.5 feet, Dupont 26 feet, Korona 29 feet, and Favoretta 28 feet.

The principal watershed enters Flagler County about 1 mile west of the southeast corner of the county and extends in a northerly direction to a point near the west-central part of Fishhawk Cypress Swamp. Here it turns northeastward to a point near where the Florida East Coast Railroad crosses the Flagler-Volusia County line, where it takes a northerly and slightly westerly course, following along the east side of Gore Lake and thence northwestward, crossing Hulett and Pringle Swamps and entering St. Johns County about 1 mile east of Big Cypress Swamp. West of this divide the streams flow northwest, west, and southwest through Crescent Lake to the St. Johns River, while to the east the drainage is carried eastward and southeastward to the Atlantic Ocean.

Comparatively small areas of Flagler County are well drained. The principal well-drained areas occur in the low-ridge region lying along the coast and in the low sand ridges about Neoga and Gore Lake. The remainder of the county, with the exception of small, scattered, low, ridgy areas of about 10 to 100 acres, is poorly drained. There are large areas in which drainage is either lacking or only partially established. Such places are conspicuously marked by many large swamps and bays, which often occupy the higher elevations. The largest of these, Big Cypress Swamp, in the northwestern part of the county, at an elevation of 23 feet, has a length of about 10 miles and a width of 1 to 7 miles. Other large swamps and bays occupying from 1 to 10 square miles are Hulett, Pringle, Fishhawk Cypress, Hull Cypress, and Grahams Swamp; Quigley, Shakey, Hoghouse, Winket, and Cross Bays; and Mound Slough. There are many smaller swamps and bays, and cypress ponds ranging from 1 to 25 acres are very numerous throughout the flatwoods.

The present streams are sluggish and have not developed valleys. It is often difficult to determine the extent of the overflow area, owing to the gradual merging of the bottoms into the upland, and along many of the stream courses the water spreads out over large areas, forming swamps and marshes. Only the larger creeks and rivers have well-defined channels. The streams generally head in swamps or bays, and in their upper reaches are merely wet-weather streams. Both creeks and branches are fringed with a heavy growth of cypress and hardwoods.

In the vicinity of Neoga there are several deep lakes without surface outlets. These probably owe their origin to limestone sinks.

Flagler County was formed in 1917. Settlement in this region began early in the eighteenth century, and was at first confined to favorable locations near the coast. The first settlers were of Spanish

descent. In 1763 Florida was ceded to the English, and in 1767 an English association formed a colony of 4,000 Europeans from the island of Minorca, island of Corsica, and the Grecian Archipelago, and settled on lands between St. Augustine and New Smyrna, including all of the Flagler County coast line. From the time of the transfer of Florida by Spain to the United States, in 1821, there was a slow inflow of settlers, mostly from the Carolinas and Georgia, but the population was sparse until the development of the potato-growing industry during the last 20 years. In this brief period many settlers have come from all parts of the United States and Canada.

According to the 1920 census the population of Flagler County is 2,442, all of which is classed as rural. It is very irregularly distributed, there being large uninhabited areas. Settlement is densest on the Bladen fine sandy loam areas between the Dean Road, Codyville, and Lake Diston. There are many farms along the Brick Road between Espanola and Ocean City and in the vicinity of Korona and Favoretta and between St. Johns Park and Big Cypress Swamp. Thirty-nine and two-tenths per cent of the population are negroes.

Bunnell, the county seat and largest town, is situated near the center of the county, on the Florida East Coast Railroad and the Dixie Highway, and is the principal shipping point in Flagler County. Dupont is an important shipping point on the Florida East Coast Railroad and the Dupont & Florida Central Railroad. Roy, New Dinner Island, Neoga, Espanola, Korona, and Favoretta are other shipping points on the Florida East Coast Railroad. St. Johns Park, in the extreme western part of the county, is provided with both railroad and water transportation. Atlantic City is both a summer and winter resort. Relay is a small "turpentine" town in the southern part of the county. Codyville is a shipping point on the Dupont & Florida Central Railroad.

The Florida East Coast Railroad crosses Flagler County diagonally from northwest to southeast. The Dupont & Florida Central Railroad connects the towns of Dupont and St. Johns Park. Water transportation is afforded in the western part of the county by Crescent Lake, and along the coast by the Florida East Coast Canal, and all parts of the county are fairly well supplied with means of transportation.

A brick wagon road (Dixie Highway) enters the northern part of Flagler County and extends southeast to Bunnell and thence east to Ocean City. The John Anderson Highway, in the eastern part of the county, and the road connecting Bunnell and St. Johns Park have hard surfaces of shell or limestone, and there are a number of other roads that are graded. Settlement and turpentine roads extend into most sections of the county, with the exception of the large swamp areas.

Local and long-distance telephone service is available in many parts of the county, and there are telegraph facilities at Bunnell, Dupont, and Espanola. Rural and star mail routes reach many of the settlements. Public schools are conveniently located throughout the county.

Early Irish potatoes are shipped to all the larger cities between Chicago and Boston. Early cabbage is shipped to Atlanta, Savannah, and New York.

CLIMATE.

The climate of Flagler County is subtropical, characterized by long summers and short, pleasant winters. Occasionally during the months of December, January, and February the temperature for periods of two or three days may drop to near the freezing point. The lowest temperature on record at St. Augustine is 13° F. and the highest is 104° F. A comparison of the records of the Weather Bureau stations at St. Augustine, which is about 16 miles north of the county and has a climate typical of that section of Flagler County along the coast, and at Federal Point, which is about 8 miles north and 1 mile west of the northwest corner of Flagler County, shows some variation in precipitation. Since there is little difference in elevation, the variation is probably due to the nearness of St. Augustine to the ocean.

The average annual precipitation is 47.15 inches at St. Augustine and 52.25 inches at Federal Point. The wet season occurs during June, July, August, and September, and the winter and spring months are the driest.

The average date of the last killing frost in the spring as recorded at St. Augustine is February 17, and that of the first in the fall, December 18. The latest date of killing frost recorded in the spring is March 27, and the earliest date in the fall, November 10. At the Federal Point station the average date of the last killing frost in the spring is February 16, and that of the first in the fall December 18, while the latest recorded date of killing frost in the spring is March 27 and the earliest recorded date in the fall November 17. The long growing season, which averages 305 days, is favorable to a widely diversified agriculture and to the extension of the stock-raising and dairying industries. Grazing continues throughout the year.

The following table is compiled from the records of the Weather Bureau stations at St. Augustine, St. Johns County, and at Federal Point, Putnam County:

Normal monthly, seasonal, and annual temperature and precipitation.

Month.	Federal Point.				St. Augustine.					
	Temperature.	Precipitation.			Temperature.			Precipitation.		
	Mean.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1911).	Total amount for the wettest year (1880).
	° F.	Inches.	Inches.	Inches.	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	54.7	3.00	3.50	2.68	57.6	87	16	2.73	1.19	1.32
January.....	56.6	2.73	.96	.67	56.5	85	18	2.62	1.55	3.22
February.....	57.8	3.18	4.63	9.53	58.6	87	13	2.90	.00	6.91
Winter.....	57.3	8.91	9.09	12.88	57.6	87	13	8.25	2.74	11.45
March.....	64.4	3.12	5.67	8.40	62.9	94	26	2.94	1.30	1.30
April.....	68.3	2.51	3.13	3.91	68.3	93	36	2.56	.78	2.08
May.....	74.7	3.64	1.43	6.83	74.0	99	45	3.32	1.02	4.68
Spring.....	69.1	9.27	10.23	19.14	68.4	99	26	8.82	3.10	8.06
June.....	79.2	6.16	3.91	6.28	79.0	104	54	5.14	4.73	5.95
July.....	81.2	6.75	3.30	4.62	80.9	101	62	5.23	1.22	11.09
August.....	81.2	6.92	5.96	9.89	80.7	101	63	5.94	5.48	8.20
Summer.....	80.5	19.83	13.17	20.79	80.2	104	54	16.31	11.43	25.24
September.....	78.5	7.40	3.46	7.29	78.5	100	51	6.50	1.14	2.57
October.....	71.9	4.79	1.68	7.87	72.3	98	38	5.00	5.83	14.29
November.....	64.0	2.05	.60	3.16	64.1	92	26	2.27	3.80	5.51
Fall.....	73.6	14.24	5.74	18.32	71.6	100	26	13.77	10.77	22.37
Year.....	69.5	52.25	38.23	71.13	69.5	104	13	47.15	28.04	67.12

AGRICULTURE.

Early in the eighteenth century the Spaniards had farms along the coast on which they grew some vegetables and staple products for their own use, but they subsisted mainly by fishing and hunting. Indigo, sugar cane, corn, sweet potatoes, cotton, and oranges were grown prior to 1800, and sugar cane and upland rice were important crops from 1830 up to the Civil War period. Stock raising was taken up by the Spanish. Practically the whole county was an open range, and stock could graze over large areas. The raising of cattle and hogs became the sole occupation of many farmers and has remained an important industry to the present time.

Late in the seventies the citrus-fruit industry began to attract attention. It developed along the coast very rapidly until the freeze of 1895, which killed most of the trees. About 1909 the production of early Irish potatoes for northern markets was started near Bun-

nell. This industry has grown rapidly and at present is the chief occupation of the county. In the eighties and nineties turpentine and lumbering were carried on rather extensively, and they are still important industries, although the forest resources are being rapidly depleted. There are sawmills at Dupont and Roy and northeast of Bunnell, and turpentine stills at Relay, Favoretta, Bulow Still, Neoga, New Dinner Island, and Roy.

At present, Irish potatoes, corn, sugar cane, cowpeas, and sweet potatoes are the principal crops. Velvet beans and oats, grown for stock feed, are probably the most important of the minor crops. The growing of citrus fruit and grapes are important industries in a few localities. Probably half the farmers are engaged in raising hogs on the open range, and some raise range cattle. Dairying is engaged in on a small scale. The principal wild grasses are wire grass and broom sedge in the flatwoods section, needle grass and bunch grass in the fresh-water marshes, and saltweed and sword grass in the salt-water marshes.

Irish potatoes are by far the most important crop. According to the 1920 census Flagler County stood third in the production of Irish potatoes in the State, being exceeded only by St. Johns and Putnam Counties, the production in 1919 being 103,561 bushels from 1,368 acres, an average of 75.7 bushels per acre.

The Spaulding Rose is the leading winter variety grown, while the Green Mountain and Lookout Mountain are the leading varieties for fall.

Corn ranks next to Irish potatoes in importance. Most of the corn is used on the farm, chiefly for feeding the stock, but to some extent for making into meal. More corn is shipped into than out of the county. The 1920 census reports 826 acres in corn with a production of 6,258 bushels.

Hay and forage crops are relatively unimportant, although they are grown to a limited extent on almost every farm. The greater part of the hay is fed on the farm to work stock and dairy cattle. Some hay is sold to local markets, but this does not supply the demand, and a large amount of hay is imported each year. Cowpeas, with a volunteer growth of crab grass, form the leading hay crop of Flagler County. The crop is grown on almost every farm, in many cases for soil improvement or for hog pasture. Oats are cut in the heading stage and cured for hay. Sudan grass is reported as giving very good results, yielding about 2 tons per acre. Other hay crops that have been tried in an experimental way, with some success, are soy beans, velvet beans, Natal grass, Para grass, Rhodes grass, fetterita, milo, kafir, and Japanese and Jerusalem cane. Many farmers grow sufficient hay for their own use. The 1920 census reports 711 acres in hay and forage crops, with a production of 770 tons.

Sugar cane is grown by most farmers, principally for making sirup, and to a small extent for sugar. The 1920 census reports 38 acres in sugar cane, and 6,361 gallons of sirup made on farms. Sweet potatoes and yams are grown in patches on most farms. In 1919 the total acreage was 124 acres, producing 11,777 bushels.

Oranges of splendid flavor and quality are produced in Flagler County. The principal groves are located on the Bladen fine sandy loam near Knights Store and on the Norfolk fine sand in the extreme eastern part of the county. Prior to the freeze of 1917 there were several groves south of St. Johns Park on the Bladen clay. Very good oranges were produced on the Bladen clay without fertilizer.

The 1920 census reports 3,501 orange trees, yielding 1,925 boxes of fruit; 339 grapefruit trees, yielding 322 boxes; and 690 tangerine trees, yielding 255 boxes.

Probably one-half of the farmers of Flagler County keep one to three cows for milk and butter, the 1920 census reporting 271 dairy cattle. Grade Jersey is the leading type of dairy cow. In addition to the native wire grass, broom sedge, crab grass, and beggarweed, pastures of cowpeas, oats, and Sudan grass are sometimes provided for the dairy cattle. Some farmers supplement these pasture grasses with cottonseed meal, ensilage of velvet beans and corn fodder or cowpea vines and corn fodder, concentrates, and dry feed.

At the time of the survey (1918) five dipping vats were being constructed in different parts of the county for the purpose of eradicating the Texas fever tick. It is generally believed that dairying will be carried on much more extensively when the eradication is effected. At present condensed milk and butter are shipped into the county in large quantities.

The raising of cattle for beef purposes is a relatively important industry. There are a few farms with herds ranging from 100 to 300 head; in most cases the herds number from 10 to 50 head. The 1920 census reports 1,023 beef cattle in the county. These cattle are of a low-grade type and in most cases receive no other feed than that obtained from the open range, which though extensive is generally poor. The maintenance of purebred bulls is very difficult on account of the prevalence of the Texas fever tick.

The hogs are of better quality than the other live stock. The importation of purebred boars and sows has resulted in great improvement on the former razorback variety. Poland-China, Berkshire, and Duroc-Jersey are the leading breeds. The 1920 census reports 2,165 hogs in the county. A large percentage of the hogs feed on the forage and mast of the swamps, hammocks, and flatwoods, and many of them are fattened by turning them into fields of cowpeas or peanuts, or by feeding corn. There is not sufficient pork and beef

produced in Flagler County to supply the local markets, and large quantities are imported.

Horses and mules are fed on about the same pasturage and roughage as the cattle, but this is supplemented with corn, oats, alfalfa meal, and various mixed feeds. Not enough horses and mules are raised in the county to meet the local demand. There are in Flagler County one flock of 3,000 sheep and a number of small flocks that graze on the open range.

All the farmers recognize differences in the adaptation of the various soils to certain crops, and the majority are guided in a measure by such knowledge in selecting their fields. It is generally realized that the Bladen fine sandy loam is the best Irish potato soil, although it is little better than the Bladen fine sand; that the Parkwood and Gainesville soils are best adapted to leguminous crops; and that the Norfolk fine sand is the best soil for sweet potatoes, sugar cane, and citrus fruits. Until the ground-water level is lowered, the hardpan broken up, and lime applied to correct the acidity, the St. Johns and Leon soils will remain practically nonagricultural. When adequate drainage is provided the Portsmouth soils are known to be well adapted to growing corn and potatoes. The Plummer fine sand, because of its low content of organic matter and poorly drained condition, is classed as an inferior soil. Owing to their lack of organic matter and their leachy nature and incoherency, the St. Lucie soils are not farmed. The Peaty muck, when reclaimed, has proved well adapted to onions, celery, and corn. The Coastal beach soil is considered nonagricultural.

The common method of preparing the seed bed for Irish potatoes is to break the ground in November or December into beds 3 or 4 feet apart with disk cultivators. There are 10 or 12 of these beds in a plat. Between the plats are water furrows, connected invariably at one end and usually at both ends with ditches, which are used for both drainage and irrigation, water for irrigating being supplied by artesian wells. Commercial fertilizer is applied in the top of the bed with the potato planter. The crop is cultivated with disk cultivators and is sprayed frequently to counteract the blight, which may do serious injury, especially during wet seasons, when not sprayed. The crop matures in about 90 to 100 days after planting.

Immediately after cultivation of the potatoes, corn is usually planted on the side of the bed, without additional fertilizer. When the potatoes are dug, the soil is turned toward the corn, leaving it in the center of the bed, where the drainage is better. The corn is worked with shovel and disk cultivators and sweeps. At the last cultivation cowpeas are usually sown broadcast, but rice is sometimes sown between the rows. When the corn is harvested—the common practice is to top the stalks and snap the ears—hogs and

cattle are often turned into the field to fatten on the cowpeas, but in many cases the vines, with the volunteer growth of crab grass, are cut for hay.

A few farmers have had excellent success in growing Sudan grass. The seed is drilled in April at the rate of 3 pounds per acre, in rows 3 feet apart. At the second cultivation seed is again drilled in between the rows at the rate of 3 pounds per acre. It is considered best to grow Sudan grass after corn and velvet beans.

In sections of the county where farming has been well developed the houses are generally substantial. Most of the fields are fenced with barbed wire, though woven wire is coming rapidly into use. Improved farm implements are used by the majority of farmers, although some still use the 1-horse turning plow and the old type of small, straight plow and sweep. Mules are used most extensively as work animals, since they are more easily kept and endure the warm weather better than horses. The mules are rather small and the horses are of a light harness type. Oxen are used to a very limited extent in clearing and breaking new land.

No definite crop rotation is practiced, although two or three crops may be taken in the same season from one field. All the farmers use commercial fertilizer for Irish potatoes, and corn, which generally follows that crop, receives benefit from the fertilization. From 1,000 to 2,000 pounds per acre of a ready mixed fertilizer is applied for potatoes. The fertilizer most commonly used consists of a mixture of cottonseed meal, blood and bone, and acid phosphate, analyzing 6 to 7½ per cent phosphoric acid and about 4½ per cent ammonia. Very little stable manure is available, but an old method of manuring the land known as "cowpenning" is practiced extensively. The stock is kept during the night in an inclosure of an acre or two, which is changed from place to place as the soil becomes sufficiently enriched. A few farmers who have plowed under cowpeas and velvet beans report a very material increase in the quantity and quality of the succeeding crop of Irish potatoes, as well as in the corn crop immediately following the potatoes. The 1920 census reports the use of fertilizer by 107 farms at a cost of \$69,045, an average of \$645 per farm.

Except during the potato harvest the farm labor is done largely by the landowner. Most of the laborers are colored. Those employed by the month are paid from \$25 to \$35, while day laborers receive \$1.75 a day ordinarily, and \$2 a day for harvesting potatoes.

With the subdivision of many of the large land holdings into 5, 10, 20, and 40 acre tracts, the average size of the farms is steadily decreasing. The size depends mainly upon the character of the soil

and to a less degree upon the condition of the roads and the nearness to towns and transportation facilities. The smaller farms are situated on the better drained tracts of the Bladen, Parkwood, and Norfolk soils.

The 1920 census reports 187 farms in Flagler County of an average size of 56.8 acres, of which 21.8 acres is improved land.

When land is rented, which is rather uncommon, the cash-rent system prevails, from \$5 to \$20 being paid per acre. Where land is rented on shares the tenant usually furnishes the labor and equipment, and receives two-thirds of the crop.

Land values are steadily increasing, with the constant inflow of settlers. At the time of the survey (1918) the selling price of uncleared areas of the better types of farming land ranged from \$30 to \$150 an acre, depending on the quality of the soil, the drainage, the character of the roads, and the distance from towns, schools, churches, and lines of transportation. Lands composed of the St. Johns, Leon, Plummer, and St. Lucie soils, Coastal beach, and Swamp could be bought for \$5 to \$30 an acre. Improved farms were held at \$100 to \$300 an acre. The higher priced land, excluding locations near the towns, consists of the Bladen, Parkwood, Norfolk, and Gainesville soils.

SOILS.

The formations of Flagler County from which the soils are derived are largely Pleistocene and Recent in age, and consist of sediments laid down by water under varying conditions of deposition. These water-transported materials now appear as unconsolidated sands, sandy clays, and clays covering the entire county, except for a few relatively small areas of coquina in the northeastern part, along the Florida East Coast Canal, and a number of small scattered beds of marl, recent-fluvial deposits, and Peaty muck beds, which occur in all parts of the county.

A very limited relation exists between the nature of the geological formation and the derived soils. This relation is evident mainly in respect to texture. Where the formation is a deep fine sand the resulting soil is a fine sand, and where the particles in the original formation are a medium sand the soil derived from it is a medium sand in texture. The sandy clay formation produces the fine sandy loams, while the clay formations give rise to the clays, which form only 4 per cent of the area of the county.

The soils of Flagler County, on the basis of origin, may be classed in four general groups: (1) Soils derived from the underlying unconsolidated formations, (2) alluvial soils, (3) cumuloose soils, and (4) miscellaneous soils. The first two groups are subdivided into

series and types. The series include soils of a common origin and having similar characteristics of color, structure, topography, and drainage. The type differentiation within any series is based upon the texture, which is dependent upon the proportions of the different grades of material—sands, silt, and clay—of which the particular soil is composed. Minor variations in the soil, not sufficient to produce type differences, are indicated as soil phases.

The soils derived from the unconsolidated sands and clays are classed mainly in the St. Johns, Bladen, Norfolk, Plummer, and Leon series, but include small areas of St. Lucie, Parkwood, Portsmouth, Lakewood, and Gainesville soils. The St. Johns, Norfolk, Plummer, Leon, St. Lucie, and Portsmouth series owe their origin to the weathering of unconsolidated sands. The Gainesville series has originated from coquina or other shelly rock intermingled with unconsolidated sands. Most of the Parkwood fine sandy loam has been derived from unconsolidated sands and marly clay or marl, the unconsolidated sands resting upon marl or marly clay beds. The Parkwood clay in some places has been derived from the marl or marly clay in situ. To the alluvial group belong a large part of the Bladen fine sandy loam, Bladen clay, and Parkwood clay; a part of the Bladen, Plummer, and Portsmouth fine sands along streams, particularly the swamp phases of these types; and some of the Parkwood fine sandy loam where it occurs along stream courses. Peaty muck, the only representative of the cumulose group, has originated from the partial decomposition of organic material in the presence of water.

The surface soils of the types in the Bladen series are gray to black in color. The subsoil is a gray to mottled brownish, yellowish, and grayish plastic loamy fine sand to clay. The Bladen soils occupy flat basins which appear to have been recently in a swampy condition.

The Lakewood series includes types characterized by light-gray or white surface soils and an orange or golden-yellow subsoil. The surface material resembles that of the Leon soils, while the subsoil is like that of the Sassafras series—a series not found in Flagler County. The Lakewood soils occupy nearly level to rolling country, and are well drained.

The Gainesville series includes types with reddish-brown to chocolate-brown surface soils and a reddish-brown subsoil, which contains fragments of shells and small pieces of coquina. These soils are developed on low ridges, and are well drained.

The types grouped in the Leon series have light-gray to almost white soils, underlain at 8 to 30 inches by a compact layer of fine sand ranging in color from dark brown to black. A white fine sand

frequently underlies this "hardpan" layer within the 3-foot section. The Leon soils occur along lakes and on sandy ridges.

The Norfolk series comprises types with a light-gray to grayish-yellow surface soil and a yellow subsoil. The members of this series occupy nearly level to gently rolling uplands, and are well drained.

The Parkwood soils are dark gray to brownish gray, and underlain by a gray, dark-brown, or mottled gray and brown, calcareous clay, which rests upon a dark-drab to almost white marly clay. The surface is flat and the drainage is very poor.

The surface soils of the members of the Portsmouth series are dark gray to black, and normally high in organic matter. The subsoil is prevailingly gray to light gray, but may be mottled with yellow and brown in the lower part. The subsoil of the heavier members is always somewhat plastic, though often carrying considerable sand. The Portsmouth soils are developed in flat to depressed, poorly drained situations. The fine sand with two phases is the only type of this series developed in Flagler County.

The surface soils of the types in the Plummer series are gray, and the subsoil is light gray or dingy gray, often mottled with yellow. The Plummer series occupies flat, poorly drained areas of the flatwoods.

The types correlated in the St. Johns series are dark gray to black in the surface soil, and gray in the subsoil, except for a dark rusty brown to black "hardpan" layer, usually 3 to 10 inches in thickness, which is encountered at a depth of 16 to 24 inches. These soils occupy low, flat or slightly depressed areas.

The types of the St. Lucie series consist of a white, loose sand extending to a depth of more than 3 feet. They occur on ridges rising above the associated flatwoods soils.

The miscellaneous soils of Flagler County are mapped as Coquina, Peaty muck, Swamp, Coastal beach, and Tidal marsh.

In the following pages of this report the various soils of Flagler County are described in detail, and their relation to agriculture discussed. The distribution of the soils is shown on the map accompanying this report, and the table below gives the name and the actual and relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Bladen fine sand.....	41,536	24.7	Peaty muck.....	8,256	2.6
Swamp phase.....	36,032		Portsmouth fine sand.....	768	1.7
St. Johns fine sand.....	72,576	23.1	Swamp phase.....	4,352	
Bladen fine sandy loam.....	36,160	14.7	Prairie phase.....	192	
Swamp phase.....	10,112		Tidal marsh.....	5,248	1.6
Leon fine sand.....	40,576	13.1	Parkwood clay.....	2,624	1.3
Scrub phase.....	704		Prairie phase.....	1,536	
Swamp.....	12,544	4.0	St. Lucie fine sand.....	3,904	1.2
Plummer fine sand.....	2,368	3.6	Marsh.....	3,200	1.0
Swamp phase.....	9,152		Parkwood fine sandy loam.....	2,752	.9
Norfolk fine sand.....	3,520	2.8	Lakewood fine sand.....	1,216	.4
Hammock phase.....	2,752		Coastal beach.....	1,216	.4
Scrub phase.....	2,176		Gainesville sand.....	192	.1
Shell phase.....	128		Coquina.....	128	.1
Bladen clay.....	5,312	2.7	Total.....	314,240
Prairie phase.....	1,536				
Swamp phase.....	1,472				

BLADEN FINE SAND.

The Bladen fine sand consists of a dark-gray or almost black fine sand, 4 to 12 inches deep, grading into a grayish to almost white loamy fine sand, which passes at about 16 inches into a gray or mottled grayish and yellowish loamy fine sand. In the lower part of the section, from 30 to 36 inches, there is normally a small amount of clay, sufficient to make the material slightly sticky.

As mapped this type is somewhat variable, the surface soil ranging from very fine sand to sand. Frequently the upper subsoil consists of a pale-yellow fine sand, which at about 18 to 24 inches passes into a bright-yellow or orange-yellow loamy fine sand. In the southwestern part of the county, south and southwest of Knights Store, the surface soil is more loamy and contains more organic matter than the average of the type, and the subsoil is a gray loamy fine sand with yellow mottlings. In the vicinity of Bunnell the surface soil is a gray loamy fine sand. Most of the areas contain small unseparated patches of St. Johns fine sand and Leon fine sand, and in a few it is difficult to determine whether or not the Bladen is the predominating type.

The Bladen fine sand is the most extensive soil in the northwestern part of the county. Large areas occur also in the southeastern part, east of Korona, about Winket Bay, and west and south of Relay. The topography is flat or nearly flat, and the drainage is poor, the type often being saturated or covered with water during rainy seasons.

This is one of the most important soils of the county, although probably not more than 5 per cent of it is cultivated, the remainder being used for pasture. The type comprises the "grassy flatwoods," "prairie flatwoods," or "meadows" of the county, and is characterized by a scattered growth of Cuban pine (*Pinus cubensis*) and some longleaf pine (*Pinus palustris*), together with wire grass, bunch grass, broom sedge, and such plants as sundew and pitcher plant.

The most important crops produced are Irish potatoes and corn, each occupying about the same acreage. Potatoes are the principal money crop. A large part of the corn is used to feed the work stock on the farm; a portion is used in the production of meat and dairy products for home use and for sale; and a small portion is ground into meal for use in the home. Cowpeas, which rank next to Irish potatoes and corn in importance, are grown for hay and also for fattening hogs and cattle. Sugar cane is grown for making sirup, and sweet potatoes for home use and for the market. Upland rice is grown mainly to be fed in bundles to stock, only a small proportion of the crop being thrashed for use in the home and for sale on the local markets. All the garden vegetables common to the region are produced for home use, and occasionally there is a small surplus for sale. Practically all the uncultivated part of the type is used as open range for cattle and hogs, the stock being branded or marked. Most of the Cuban pine has been "boxed" for turpentine. Citrus fruits and Muscadine and bunch grapes have been found to do well on this soil. Bermuda grass makes a good permanent pasture, while oats, barley, or rye sown in September or October provide good winter pasturage.

Irish potatoes on this soil range in yield from 10 to 85 barrels per acre, but because of the blight the average yield is about 25 to 35 barrels. Corn yields 15 to 35 bushels per acre, averaging about 25 bushels, and sugar cane from 10 to 170 gallons per acre, averaging about 50 gallons. The maximum yields are obtained where cowpeas or velvet beans are plowed under and where the farmers understand and supply the fertilizer needs of the soil. Most farmers plow in December and divide the field into plats, consisting of about 12 rows. Between these plats are deep water furrows for both drainage and irrigation. From 1,000 to 2,000 pounds of commercial fertilizer, consisting of about 6 to 7.5 per cent available phosphoric acid and 4.5 per cent ammonia, is applied. Irish potatoes are planted about the middle of January. At the last working of the potatoes corn is planted on the side of the bed, without additional fertilizer. When the potatoes are dug the soil is turned about the corn, leaving the corn in the center of the bed. At the last working of the corn, cowpeas are sown on both sides of the bed. After the corn is topped

and the ears snapped, hogs and cattle are turned into the field to fatten on the cowpeas.

Unimproved areas of Bladen fine sand sell at \$20 to \$50 an acre, depending upon the condition of the roads, the amount of clearing, and the distance from towns and railroad stations. Where the land is cleared, fenced, and ready for cultivation the prices range from \$75 to \$200, with an average of about \$100, an acre.

Artificial drainage is invariably necessary for the best results on this soil. Drainage districts have been established throughout the county and canals are being constructed. The maintenance of a supply of organic matter in the soil is essential. This may be accomplished by liberal applications of barnyard manure and by green manuring. The growing of leguminous crops will greatly improve the soil, and less nitrogen will be required in commercial fertilizers. By plowing under cowpeas and velvet beans as green manures, several farmers have obtained a better quality of Irish potatoes and an increase in yield of about 7 barrels per acre, as well as a very substantial increase in yield in the immediately succeeding corn crop. The soil is well suited to the prevailing type of general farming.

Bladen fine sand, swamp phase.—The Bladen fine sand, swamp phase, consists of 1 to 12 inches of mucky material, beneath which is a gray or pale-yellow fine sand, passing in the lower subsoil into a sticky, yellow, drab, or mottled yellow and drab fine sand or fine sandy loam. Lenses of fine sandy clay are present in places. Areas without mucky surface occur.

The Bladen fine sand, swamp phase, is the most extensive swamp soil in Flagler County. Its largest occurrence is in Big Cypress Swamp in the northwestern part of the county, but many other areas, ranging from a few acres to several hundred acres, are found in swamps and shallow basins in all parts of the county.

The surface is basinlike, the phase lying 1 to 4 feet below the general level of the typical Bladen fine sand. It has very poor drainage, being covered with water, except during long dry periods. It supports a growth of pond cypress, bald cypress, water oak, willow oak, sweet gum, black gum, tupelo gum, and myrtle, with sphagnum and club mosses in the wetter areas. There is some Cuban pine on the bases or "knees" of the cypress trees.

The Bladen fine sand, swamp phase, is used as pasture land. Lumber companies are cutting the cypress timber in the larger swamps, and some turpentine is obtained. The soil is not cultivated, on account of the excessive moisture, but when drained it soon loses all swamp characteristics and is adapted to all the crops grown on the typical Bladen fine sand.

BLADEN FINE SANDY LOAM.

The Bladen fine sandy loam consists of a gray to dark-gray or dark-brown loamy fine sand, 5 to 12 inches deep, grading into a gray loamy fine sand, mottled with yellow, that gradually becomes heavier with increase of depth until the drab, bluish-drab, mottled yellow and drab, or yellow plastic clay subsoil is reached at 12 to 30 inches. The type as mapped is not uniform. To the north and northwest of Dean Still the surface soil is shallow, the heavy clay outcropping in places. Such spots are poorly drained. In many places the clay subsoil is very friable, owing to a large amount of fine sand. The surface soil may be mottled with yellow in places. Between Dean Still, Haw Creek, and the Volusia County line there is a gradation between this soil and the Bladen clay, the plastic clay rarely ever being deeper than 15 inches. In secs. 5 and 6, R. 30 E., T. 14 S., the loamy fine sand extends to a depth of 30 to 36 inches, where a sandy clay is encountered. In the vicinity of St. Johns Park the surface soil is a dark-gray very fine sandy loam or loamy very fine sand, passing at about 14 inches into a gray very fine sand and at about 18 inches into a mottled gray and yellow sandy clay. At 30 inches a heavy very fine sandy loam is encountered. South of Shell Bluff there is usually about 3 inches of black loamy fine sand at the surface. Northwest of Shell Bluff, along the northeast shore of Crescent Lake, the surface soil is a light-gray fine sand, passing at about 18 inches into a brown, ferruginous, organic hardpan material. At 20 to 22 inches a drab or gray friable clay is encountered. Low-lying dome-shaped mounds of Leon fine sand and St. Johns fine sand are of common occurrence in the areas of Bladen fine sandy loam, and there are also many included patches of Bladen fine sand and some of Bladen clay.

The Bladen fine sandy loam is developed in large areas between Bunnell and Codyville on the east and St. Johns Park and Lake Diston on the west. Small areas occur west of the southern extremity of Hull Cypress Swamp, along Pringle Swamp, north of Espanola, southeast of Hulett Swamp and south and west of Malcompre Well.

This is the most important soil type in the county, although it is unsuitable for cultivation without artificial drainage. Perhaps 25 per cent of it is under cultivation. The forested areas support a growth of Cuban pine, with grasses, sedges, and saw palmetto; in places there is a heavy hammock growth consisting of live oak, cabbage palmetto, gum, magnolia, myrtle, and groundsel bush. There are a few small patches of longleaf pine.

Irish potatoes and corn are the chief crops grown, occupying about the same acreage. Cowpeas, sweet potatoes, oats, and sugar

cane, ranking in acreage in the order named, are other important crops. Cabbage and celery are grown for the early markets in the vicinity of Knights Store. Upland rice, velvet beans, sorghum, Bermuda grass, Para grass, Sudan grass, Natal grass, and all the garden vegetables common to the region are grown to a small extent. Possibly 50 per cent of the farmers keep cows to supply their own milk and butter. A few farmers in the vicinity of Knights Store have small commercial groves of oranges, tangerines, and grapefruit. Muscadine and Concord grapes do very well on this type but are not extensively grown.

The producing of early Irish potatoes has become a very important industry in the vicinity of Knights Store, Bunnell, and St. Johns Park. Early potatoes mature from about April 10 to May 15.

Irish potatoes vary greatly in yield, from 10 to 100 barrels per acre, with an average of 35 to 40 barrels. Corn yields from 15 to 45 bushels per acre, with an average of about 25 bushels.

The Bladen fine sandy loam responds readily to improved methods of management and fertilization. It is handled in practically the same way as the Bladen fine sand. Where potatoes are dug early, corn is planted after the crop instead of on the side of the bed at the last working of the potatoes. In this case the potatoes are dug with modern machinery instead of by hand. The crop of cowpeas, which follows the corn, together with the volunteer growth of crab grass, is usually cut for hay, but is sometimes pastured.

All the farmers use commercial fertilizer for Irish potatoes, the same brands and amounts being employed as in the case of the Bladen fine sand. Stable manure has been used with good results. "Cowpenning" is a popular method of fertilizing land for sweet potatoes and other crops. During periods of extreme dry weather some crops, especially Irish potatoes, tend to suffer from lack of moisture, and water is supplied from artesian wells, being conveyed to the crops through the same ditches or tiles that are used for drainage during periods of excessive moisture. The artesian water, because of its relatively high temperature, is also valuable as a protection from frosts.

Uncleared areas of the Bladen fine sandy loam range in selling value from about \$25 to \$100 an acre, depending upon the condition of the roads and the location with respect to towns and railroad stations. Improved farms range from \$100 to \$300 an acre.

Although the Bladen fine sandy loam is a strong, easily cultivated, and readily improved soil, many fields have decreased in productivity owing to dependence on commercial fertilizer year after year to maintain fertility. The practice should be modified to provide for the addition of organic matter to the soil in growing Irish pota-

toes. In a few cases, where green cowpeas have been plowed under, a very noticeable increase in the yields has resulted. More beef and dairy cattle and hogs could be raised profitably on this land. Corn and velvet-bean silage gives excellent results as a feed for dairy cows and other cattle, and should be fed much more extensively. Tile drainage is very beneficial. It makes the soil dry out earlier after rains, permits better aeration and oxidation of organic matter, leaches out injurious salts and acids, favors during the wet part of the year the development of a better root system with which to endure the droughts that may come later, and warms the soil so that the growing period is lengthened.

Bladen fine sandy loam, swamp phase.—The surface soil of the Bladen fine sandy loam, swamp phase, is a dark-gray to black, loamy fine sand, underlain at depths ranging from 4 to 10 inches, but ordinarily about 8 inches, by a dull-gray or mottled yellow and gray fine sand to loamy fine sand. This passes at about 14 to 30 inches into a yellow, drab, or mottled drab and yellow plastic to friable clay. In the wetter areas the material to a depth ranging from 1 to 16 inches often consists of a black to brown muck or peat. In some places the upper subsoil is a light-gray to almost white fine sand, gradually giving way to a drab or mottled drab and yellow plastic to friable clay. There are places where the stratum of clay is 2 to 6 inches thick and underlain by loamy fine sand.

The largest development of this phase is in the flood plain of Sweetwater Branch. Other areas are found in Big Cypress and Pringle Swamps, west of Jack O'Neck Island, about Quigley Bay, south of Winklet Bay, and south of Dean Still. Small bodies occur throughout the Bladen fine sandy loam. While the surface is pre-vaillingly flat, it is broken along Sweetwater Branch by sloughs and stream channels and by occasional depressions and other inequalities due to erosion by overflow water. The natural drainage is very poor, water standing on the surface for long periods after heavy rains.

Because of its poor drainage this soil is not cultivated, being used as range for cattle and hogs. It supports a growth of Cuban pine, pond pine (*Pinus serotina*), water oak (*Quercus nigra*), willow oak (*Quercus phellos*), live oak (*Quercus virginiana*), laurel oak (*Quercus laurifolia*), pond cypress (*Taxodium distichum imbricarium*), bald cypress (*Taxodium distichum*), water gum (*Nyssa biflora*), tupelo or cotton gum (*Nyssa sylvatica*), silver maple (*Acer saccharinum*), loblolly bay (*Gardonia tasiianthus*), cabbage palmetto, myrtle, and groundsel bush.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Bladen fine sandy loam:

Mechanical analyses of Bladen fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
261801.....	Soil.....	0.2	7.6	9.3	73.2	1.8	5.0	2.8
261802.....	Subsoil.....	.1	6.7	8.1	66.4	1.6	5.0	11.9
261803.....	Lower subsoil...	.2	6.2	7.7	54.1	1.8	5.3	24.7

BLADEN CLAY.

The Bladen clay consists of a dark-gray, dark-brown, or almost black, stiff clay, passing at 6 to 12 inches into a gray to dark-gray plastic clay, which is mottled slightly with yellow. At 15 to 24 inches a gray or mottled gray and yellow silty clay loam, sandy clay loam, or fine sandy loam is encountered, and this continues to a depth of 3 feet or more. The shifting of the stream currents has caused considerable variation in the stratigraphy of the 3-foot section. In parts of the flood plain most remote from the stream channel and in other places where the water movement has been very sluggish at the time of deposition, the gray to dark-gray clay continues to a depth of more than 3 feet, but where the stream current has been comparatively swift the surface soil is often a black sandy clay, grading quickly into a fine sandy loam. A high content of organic matter gives the soil its characteristically dark color. North of Tipperary the Bladen clay is a dark-gray to almost black, heavy, plastic clay, passing at about 10 inches into a very sticky, bluish-gray clay which at about 24 inches becomes lighter in color. At about 3 feet a steel-gray, plastic clay, with brownish-gray mottlings, is encountered.

The Bladen clay occurs principally in the vicinities of Tipperary and Saplings, and southeast of Mud Lake. The type occupies old flood plains along streams, and is subject to inundation at times of very high water.

On account of its poor drainage the Bladen clay is not cultivated, but it is used to some extent for pasture. The swampy areas rather remote from the streams support a growth of pond cypress and bald cypress, while the first-bottom areas near the streams and subject to frequent inundations support a hammock growth consisting of live oak, water oak, willow oak, Cuban pine, tupelo gum, sweet gum, black gum, haw, silver maple, hickory, and magnolia.

This is one of the strongest soils of the county, and it is believed that ditching and the construction of levees, where needed, would prove profitable. Owing to the naturally heavy texture and compact structure cultivation is much more difficult than upon the prevailingly

sandy textured soils with which the type is associated, the type being sticky when wet and clodding upon drying. Cultivation and plowing must be done when the moisture condition is right. The soil should be harrowed immediately after it is plowed, in order to break the clods before baking takes effect. The use of lime will correct the acidity of the soil and improve its physical condition. With proper treatment this will be found to be one of the best corn soils of the county.

Bladen clay, swamp phase.—Except in drainage, the swamp phase differs little from the typical Bladen clay. The soil is a dark-gray, dark-brown, or black plastic clay, underlain by a gray to dark-gray plastic clay, mottled with yellow. This usually grades downward into a silty clay loam, sandy clay loam, or fine sandy loam, but in the vicinity of Tipperary the soil is often a dark-gray to bluish-gray plastic clay to a depth of 3 feet or more.

This phase occupies the flood plains along Little Haw Creek, Haw Creek, and Hunters Branch, and shallow basins west and northwest of Dean Still. It remains in a swampy condition throughout the greater part of the year and supports a growth of cypress, oak, haw, gum, maple, hickory, and magnolia. The phase is not under cultivation, but provides pasturage for cattle and hogs.

Bladen clay, prairie phase.—The prairie phase is essentially the same as the typical timbered Bladen clay, except for the absence of trees and the slightly higher elevation. Only the highest waters submerge this soil. It is not farmed, but supports a growth of prairie grasses which furnish pasturage for cattle and hogs. The suggestions made for the improvement of the typical Bladen clay are applicable also to this phase.

Below are given the average results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Bladen clay:

Mechanical analyses of Bladen clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
261809, 261819.	Soil.....	0.1	1.9	2.5	31.9	8.7	18.2	36.6
261810, 261820.	Subsoil.....	.1	1.7	2.3	29.9	8.6	16.2	40.9
261811.....	Lower subsoil...	.1	2.5	3.4	38.9	4.6	10.1	40.2

LAKEWOOD FINE SAND.

The surface soil of the Lakewood fine sand is a light-gray to white, incoherent fine sand, ranging in depth from 16 to 30 inches. It is underlain by a pale-yellow to orange-yellow loose fine sand. In a few places the subsoil is underlain at 20 to 28 inches by coquina, shell

rock, or limestone, such areas really representing the Dade fine sand mapped elsewhere in Florida. Locally the surface few inches has a dark-gray color due to the accumulation of organic matter.

The Lakewood fine sand occurs in long, narrow strips, parallel to the coast, between Malcompre Well and Ocean City. It is developed on the tops of ridges, and the surface varies from almost level to ridgy and hummocky. The drainage is everywhere good or even excessive.

This soil has a very low agricultural value for general crops, and practically none of it is farmed. The vegetation consists of scrubby evergreen oak, sand pine, saw palmetto, and a scattering of Cuban pine, scrub oak, rosemary, and myrtle. There is practically no grass or undergrowth, and where the soil has been leached out or beaten by the rain it presents a barren or desertlike appearance.

GAINESVILLE SAND.

The surface soil of the Gainesville sand is a reddish-brown to chocolate-brown sand to loamy sand, about 8 inches deep. The subsoil is a reddish-brown loamy, calcareous sand, containing fragments of shells and small pieces of coquina. Often the coquina rock is encountered in the 3-foot section. Where the bedrock is very near the surface the surface soil has an orange color, but where it is 4 feet or more beneath the surface the color is much lighter.

This type is confined to long, low ridges along the Florida East Coast Canal in the eastern part of the county. It has good drainage.

About 40 per cent of the type is under cultivation. The remainder supports a hammock growth of live oak, cabbage palmetto, hickory, magnolia, and saw palmetto. Corn, cane, vegetables, and citrus fruits all produce well on this soil without fertilizer.

Unimproved land is held at about \$30 an acre, while improved land ranges from \$50 to \$70 an acre, depending largely upon the development.

LEON FINE SAND.

The Leon fine sand consists of a gray to dark-gray fine sand 1 to 5 inches deep, overlying a light-gray to almost white, rather incoherent fine sand, which at depths varying from 8 to 30 inches, though usually between 15 and 22 inches, passes into a dark-brown or rusty-brown and sometimes black dense hardpan layer. This ranges from 3 inches to 2 feet in thickness and is underlain by a moist and compact white fine sand, which when disturbed becomes incoherent and has the nature of quicksand. Included with the type are small areas of St. Johns fine sand, Plummer fine sand, and Bladen fine sand, the extent of which did not warrant separation.

A notable variation appears where the Leon fine sand is associated with the Bladen soils. Here both the soil and subsoil, except the hardpan layer, show a distinct loaminess and sometimes there is a slight stickiness and a mottled gray and yellow color below the hardpan layer in the lower subsoil. This is a better soil than that of more typical areas.

The Leon fine sand is most extensively developed in the southern part of the county, between Middle Haw Creek and Lake Diston. Areas ranging from a few acres to 1 square mile in extent are common in all parts of Flagler County.

The type lies slightly higher than the St. Johns fine sand, and somewhat lower than the Norfolk fine sand. It occurs on sandy ridges which form the divides of streams in the flatwoods and borders around the lakes. The loose, open structure of the soil and the small quantity of organic matter present tend to make the drainage excessive, and even under ordinary conditions crops suffer from lack of moisture. The hardpan layer, being impervious, prevents the capillary rise of moisture from the saturated sand underlying it.

Practically none of this type is under cultivation and it is generally considered of low productiveness. Its principal use is for grazing. The type supports a characteristic native vegetation of Cuban pine, scrubby saw palmetto, oak runner, wire grass, broom sedge, gallberry, dog fennel, and false huckleberry.

Land of this type ranges in selling price from \$5 to \$50 an acre, depending upon the amount and character of the timber, the condition of the roads, and the distance from towns and railroads.

Owing to the high cost of clearing, the difficulty of drainage on account of the ditches filling with loose, wet sand, and the inferior quality of the soil, the greater part of this type is best suited to grazing and forestry. However, this soil might be used for cultivated crops if the hardpan layer were broken up by deep subsoiling or by blasting, so as to permit the moisture to rise. The destructive method of burning off the vegetation should be discontinued, and large quantities of organic matter should be supplied by either the application of manure or the plowing under of green crops. From 2 to 3 tons of ground limestone should be applied to each acre, to correct the acidity. The growing of leguminous crops, such as cowpeas, velvet beans, crimson clover, vetch, snap beans, and soy beans, would furnish a large amount of nitrogen, so that this element could be partly eliminated in the fertilizer mixtures. Irrigation is necessary for the best agricultural utilization of the type.

Leon fine sand, scrub phase.—The scrub phase of the Leon fine sand is characterized by its scrub vegetation of evergreen oak. The soil is essentially the same as that of the typical Leon fine sand, ex-

cept that the hardpan layer is somewhat deeper. This phase is in-extensive. It occurs in the extreme eastern part of the county, one-fourth to 3 miles from the ocean, occupying ridges which extend in a northwesterly and southeasterly direction, parallel with the coast line.

NORFOLK FINE SAND.

The Norfolk fine sand, to a depth of 5 or 6 inches, is a light-gray, incoherent fine sand, sometimes slightly darkened at the surface with organic matter, particularly in the flatter areas. The subsoil to a depth of 36 inches or more is a yellowish-gray to pale-yellow, loose fine sand. Occasionally both soil and subsoil are coarser or finer than typical.

This type occurs in large areas in the northeastern corner of the county, along Pellicers Creek. Small areas are developed along Bulow Creek, east of Hulett Swamp, south of Lake Diston and in the vicinity of Espanola.

The type occurs characteristically on ridges or undulating highlands, and is well drained. Around lakes and along streams the slopes are sometimes abrupt. In the vicinity of Espanola and in the extreme northwestern corner of the county the surface is flat. On ridges and on the steeper slopes the soil is inclined to suffer from excessive drainage, by reason of its open, loose structure.

Probably 20 per cent of the Norfolk fine sand is in cultivation, while the remainder serves as range for cattle and hogs. The virgin timber growth is Cuban pine, but where this has been removed a growth of forked-leaf blackjack oak has sprung up. Wire grass is common in the uncleared areas.

The principal crops on this type are corn, cowpeas, sweet potatoes, sugar cane, and peanuts. Corn yields 10 to 20 bushels per acre with fertilization. Each farm supplies garden vegetables for home use. There are small orange groves about Pellicers Creek. Citrus fruits do well, but require heavy fertilization. Muscadine grapes do very well on this soil, and are grown for the making of wine. Until a few years ago there were vineyards of the improved bunch grape, the Niagara variety doing especially well. Pecans, olives, and Japanese persimmons have been grown with success, but on a very limited scale. A common and efficient method of fertilization practiced by the farmers on this type is "cowpenning."

Uncleared land of this type has a selling value of \$15 to \$40 an acre, according to the location. Land cleared and ready for the plow ranges from \$50 to \$150 an acre, depending upon the improvements, the distance from towns, and the transportation facilities.

The Norfolk fine sand, owing to its topography and loose, open structure, is droughty during dry periods, and irrigation is necessary

for successful truck farming. This can only be accomplished by the sprinkling method, as the deep, porous soil will not permit subirrigation. The type is very deficient in organic matter, and this should be supplied by the liberal application of barnyard manure and the plowing under of vegetation, so as to increase the moisture-holding capacity and provide plant food. The application of lime will correct the acidity and will be found especially helpful in growing legumes. On this same type of soil in other sections of Florida watermelons do very well with applications of about 1,000 pounds of fertilizer to the acre.

Norfolk fine sand, shell phase.—The Norfolk fine sand, shell phase, to a depth of about 12 inches, is a dark-brown loamy fine sand in which are incorporated large quantities of oyster-shell fragments. The surface is thickly strewn with this material, and the soil is known locally as "shell land." The subsoil is practically free from shell fragments and is comparable to that of the typical Norfolk fine sand in texture, structure, and color. These shells seem to represent the remnants of shells applied to the land prior to 1819 by the Spaniards. Writers tell that the Spaniards had a method of improving the land by covering it with shells, and in some places this covering was a foot thick.

This phase occurs in long, narrow areas parallel with the coast. It lies slightly higher than the remainder of the county, and is well drained. Some of the first farms of Flagler County were located on this soil. It is one of the most productive fine sands of the county, and about 30 per cent of it is under cultivation. It supports a hammock growth of live oak, magnolia, hickory, bay, and cedar.

Corn, oats, and all the common vegetables do well on this soil. Irish potatoes produce fair yields. The presence of lime keeps the land in a sweetened condition, so that it is especially adapted to the growing of legumes.

Norfolk fine sand, hammock phase.—The Norfolk fine sand, hammock phase, is a light to dark gray loose fine sand to a depth of 2 to 7 inches, the darker color and somewhat loamy character of the material being due to the presence of organic matter. Below this surface layer is a yellow, pale-yellow, or grayish-yellow fine sand, which is sometimes slightly loamy. In places a dark-gray to rusty-brown, hardpanlike layer, a few inches thick, is encountered from 18 to 24 inches. Both above and below this layer the material has the characteristic pale-yellow or yellow color of the Norfolk series. In places the texture of both the soil and subsoil approaches that of a medium sand.

This phase occurs in long, narrow belts parallel with the coast line between St. Johns and Volusia Counties. The topography ranges

from almost level to undulating or gently sloping and drainage is good.

Although comparatively inextensive, the Norfolk fine sand, hammock phase, is an important soil. Probably 10 per cent of it is cultivated, while the remainder serves as range for stock. A distinguishing characteristic of the phase is the hammock growth, consisting principally of live oak, cabbage palmetto, magnolia, and hickory.

Practically the same crops are grown, and similar yields are obtained, as on the typical Norfolk fine sand. Because of its favorable position with reference to bodies of water, the growing of citrus fruits has given very excellent results, and some of the best groves in Florida are located on this soil. The methods of improvement suggested for the typical Norfolk fine sand are applicable also to this phase.

Norfolk fine sand, scrub phase.—The Norfolk fine sand, scrub phase, consists of a thin veneer of incoherent white fine sand, which is usually less than 1 inch in thickness but may be 10 inches deep, underlain by pale-yellow, loose fine sand which extends to a depth of 3 feet without any important change.

This phase is developed in the eastern part of the county, from one-half to 5 miles from the coast, and occupies long, narrow ridges, 3 to 10 feet higher than the surrounding soils, and extending parallel to the coast line.

The topography is rather billowy, and shows evidence of eolian erosion and deposition. The porous nature of the soil permits rain water to pass rapidly downward to considerable depths, resulting in excessive drainage.

Agriculturally the Norfolk fine sand, scrub phase, is not important, only about 1 per cent of it being farmed. It supports very little grass for grazing. The timber growth consists mainly of sand pine (*Pinus clausa*), blackjack oak, Cuban pine, and a few live oaks. Saw palmetto, low-growing shrubs, and grapevines form the undergrowth. The suggestions made for the improvement of the typical Norfolk fine sand are applicable also to this phase.

PARKWOOD FINE SANDY LOAM.

The surface soil of the Parkwood fine sandy loam is a dark-gray, loamy fine sand, 2 to 6 inches deep, passing into a brownish gray or gray fine sand that extends to a depth of about 8 to 16 inches. The upper subsoil varies from a yellow or gray calcareous fine sandy loam to a mottled yellow and gray, gray, or dark-brown calcareous clay loam or clay. This material, at about 16 to 20 inches, is underlain by a light-gray, mottled gray and yellow, or nearly white sandy

marly clay. Usually the calcareous material increases with depth, in the lower subsoil in spots being almost a pure white marl. There are places where the marl passes into a substratum of light-gray or bluish-white fine sand, while in other places a noncalcareous, stiff, drab or bluish-drab clay underlies the marly clay. Sometimes small fresh-water shells are scattered over the surface and disseminated throughout the soil section.

The Parkwood fine sandy loam is developed in long, narrow areas extending roughly parallel with the coast between the ocean and Kings Road from Pellicers Creek south to the Volusia County line. Other areas are found south of Shell Bluff and east of Gore Lake. The type occurs characteristically in shallow basins or low hammocky areas, and is very poorly drained, water standing on the surface of a large part of the type during rainy seasons.

This soil is considered very productive, but because of its poor drainage and the cost of removing the heavy hammock growth, less than 5 per cent of it is cultivated. The timber growth is especially heavy and the trees are large. The growth consists of live oak, water oak, Cuban pine, cedar, cabbage palmetto, gum, ironwood, hickory, elm, maple, ash, persimmon, magnolia, bay, and holly, with an undergrowth of vines, saw palmetto, briers, myrtle, and shrubs in places. In some areas the tree growth is confined almost wholly to cabbage palmetto, while in others there is a mixed growth of hardwoods and pine and a scattering of cabbage palmetto.

Uncleared tracts of the Parkwood fine sandy loam are held at \$25 to \$100 an acre.

In most cases this type is favorably situated for artificial drainage, and with good drainage it is especially well suited for the production of the general farm crops and for trucking. On Drayton Island, in Putnam County, citrus fruits have done very well on this type with relatively small quantities of fertilizer.

PARKWOOD CLAY.

The Parkwood clay consists of a dark-drab to black, heavy, plastic clay, 6 to 10 inches deep, resting upon a lighter colored clay which grades into a grayish-drab clay, mottled with yellow. This contains marl and often shell fragments. The lower subsoil is usually a drab to dark-drab, marly clay.

The largest area of Parkwood clay occurs in Grahams Swamp, in a belt 10 miles in length and averaging about one-fourth mile in width. This extends in a northwest-southeast direction parallel with the ocean shore line. Another area occurs on the west side of Pringle Swamp.

The surface is flat and is subject to inundation from streams. Because of its poor drainage the type is not cultivated, but it is recog-

nized as a very fertile soil. The tree growth consists of cabbage palmetto, cedar, maple, live oak, gum, bay, cypress, and magnolia.

Land of the Parkwood clay can be bought for \$40 to \$70 an acre, the price depending largely upon the character of the timber.

When drained this will be a strong, productive soil, particularly adapted to the growing of corn, legumes, and general farm crops.

Parkwood clay, prairie phase.—The Parkwood clay, prairie phase, consists of 2 or 3 inches of dark-drab to black clay, underlain by a lighter colored clay, containing considerable marl, which at about 6 or 8 inches passes into a gray, mottled with yellow, clay, high in marl. Around the outer boundaries of this phase a veneer of a few inches of fine sand often overlies the clay.

This phase is found in a number of areas east of Grahams Swamp. The surface is flat and is covered with water a large part of the year. With the exception of 40 acres, which have been drained and put under cultivation, the land supports a vegetation of coarse grasses and a few scattered willow trees. Corn, the only crop grown, yields 35 to 40 bushels an acre without fertilizer. Unimproved land of this phase is held at about \$50 an acre.

PORTSMOUTH FINE SAND.

The Portsmouth fine sand consists of a very dark gray to black, loamy fine sand, high in organic matter, grading at 5 to 10 inches into a gray fine sand which is sometimes mottled with yellow or brown in the lower portion of the subsoil. The lower subsoil is usually saturated, and where exposed the material has a tendency to flow. East of Bulow Still, where the type supports a heavy hammock growth, the black surface soil is almost a fine sandy loam. Small areas of Scranton fine sand—a soil mapped in other areas in the State—are included with this type, the subsoil here being a grayish-yellow or yellowish-gray fine sand, with brownish-yellow mottlings.

The Portsmouth fine sand occurs in the eastern part of the county, between Kings Road and the Florida East Coast Canal, occupying long, narrow areas which extend parallel with the coast. The topography is flat, and the resulting poor drainage almost prohibits cultivation, artificial drainage being necessary before the type can be used for general farming purposes. The vegetation consists of a scattered growth of Cuban pine and a rather heavy growth of grasses.

Portsmouth fine sand, swamp phase.—The swamp phase of the Portsmouth fine sand consists of 5 to 12 inches of black, loamy fine sand to mucky fine sand or loam, underlain by gray to light-gray fine sand which extends to depths of more than 3 feet.

There are a few small areas representing the Hyde fine sand, the black soil here being underlain by black to dark-gray fine sand to a depth of more than 36 inches. This phase is extensively developed

in Hulett and Matanzas Swamps, in a number of small areas in the swampy basins of the flatwoods, and in drainage-way depressions where the flow is intermittent and sluggish.

The Portsmouth fine sand, swamp phase, is characterized by a heavy growth of pond cypress, bald cypress, bay, hickory, sweet gum, black gum, tupelo gum, swamp maple, water oak, willow oak, laurel oak, live oak, ash, elm, cabbage palmetto, pond pine, magnolia, persimmon, and myrtle, with an almost impenetrable network of vines, briars, and shrubs in many places.

Only a few acres of this phase have been drained and put under cultivation, but some of the best corn crops of the county have been grown. Good results would probably be had with onions, celery, and cabbage. The addition of lime is usually beneficial on soil of this character after it has been drained.

Portsmouth fine sand, prairie phase.—The Portsmouth fine sand, prairie phase, consists of 6 to 14 inches of black, loamy fine sand to mucky fine sand, underlain by gray fine sand. This phase occurs in a number of small areas which are rarely more than 3 miles from the coast line. It occupies ponds, marshes, and sloughs, and its surface is basinlike. It has very poor drainage, being covered with water much of the year. It supports a heavy growth of saw grass, needle grass, and bunch grasses, and is used to a limited extent for pasture and the cutting of marsh hay. It is not cultivated, though by means of ditching, and in some cases leveeing, part of it could be used with profit for growing corn, onions, celery, and cabbage.

PLUMMER FINE SAND.

The surface soil of the Plummer fine sand is a gray to dark-gray fine sand, 4 to 8 inches deep. The immediate surface material contains considerable organic matter, which gives it a dark color and a loamy feel. The subsoil is a light-gray or dingy-gray loose fine sand, of the nature of quicksand. In some places it is mottled with yellow, while in others it is pale yellow throughout. Included with the type are small mounds of St. Johns fine sand and Leon fine sand, which are conspicuous because of a growth of saw palmetto and gallberry bushes. In many places the type is so intimately associated with the Bladen fine sand that it is very difficult to determine where the boundary should be placed between the two types.

The Plummer fine sand occurs in large areas northwest of Lake Diston and south of New Dinner Island. Small areas are scattered throughout the county. The type occupies flat, poorly drained areas, and the subsoil is water-soaked, except during long-continued dry periods.

This is an unimportant soil. It is not under cultivation, but is used for grazing purposes. It supports a scattered growth of Cuban pine, with an undergrowth of wire grass, broom sedge, sundew, pitcher plant, saw grass, bunch grass, crab grass, and rushes.

Land of this type ranges in selling price from \$5 to \$50 an acre, depending largely upon the location.

With the same treatment as is suggested for the Bladen fine sand, fair yields of truck and general farm crops could be produced on this soil.

Plummer fine sand, swamp phase.—The swamp phase is similar to the typical Plummer fine sand in color, structure, and texture. The surface soil is a gray to dark-gray somewhat loamy fine sand, passing at 4 to 8 inches into a gray or dingy-gray loose fine sand which continues to a depth of more than 3 feet with an almost uniform texture and structure.

This phase is developed in large areas in Big Cypress Swamp and in the vicinity of Korona. Smaller areas are found in almost every part of the county, usually along stream courses or in shallow basins. Drainage is very poor, the soil being submerged during wet seasons.

The Plummer fine sand, swamp phase, is unimportant, except as range for cattle and hogs. The forest growth in the large swamp areas consists mainly of pond cypress and bald cypress, but in the smaller areas, especially along stream branches, there is a growth of gum, oak, maple, bay, ash, magnolia, elm, hickory, and myrtle.

Because of its porous, loose nature, this soil in general can best be used as range for stock. Some areas, however, such as those in Big Cypress Swamp, which resemble the Bladen fine sand, can, by means of proper drainage, irrigation, and fertilization, such as are suggested for the Bladen fine sand, be made to produce fair yields of truck and general farm crops.

ST. JOHNS FINE SAND.

The St. Johns fine sand consists of a dark-gray to black loamy fine sand, 5 to 10 inches deep, grading into a dingy-gray to almost white fine sand which is underlain at depths ranging from 10 to 36 inches, but usually 18 to 24 inches, by a black to dark-brown, compact fine sand, or hardpan. This layer of hardpan, which averages 3 to 4 inches in thickness, but has a range from 1 to 24 inches, is underlain by a dark-brown fine sand, which when disturbed is loose and incoherent and will flow like quicksand. The black color of the surface soil is due to the presence of organic matter, which varies in quantity from merely enough to impart a dark color to quantities sufficient to give a mucky character to the material in swampy areas. Where this type is associated with the Bladen soils, both the soil and sub-

soil, except in the hardpan layer, show a distinct loaminess, and sometimes there is a slight stickiness and a yellowish-gray or mottled gray and yellow color below the hardpan layer in the lower subsoil. In a few places where associated with the Bladen fine sandy loam a drab or yellowish-drab clay is encountered immediately under the hardpan. Where the type is developed in association with the Leon and Bladen soils the surface soil is lighter colored than typical. There are numerous inclusions of Leon fine sand and Bladen fine sandy loam, the extent of which did not warrant separation.

The St. Johns fine sand is found in all parts of the flatwoods sections, and is the predominating type in the eastern half of the county. It is flat and poorly drained, water standing on the surface in the slight depressions for long periods after rains.

Less than 3 per cent of the St. Johns fine sand is under cultivation, by far the greater part of it being used as a range for cattle and hogs. Practically all of the type supports a forest growth of Cuban pine (*Pinus cubensis*), which is either "boxed" for turpentine or is being cut for lumber. There are a few small patches of long-leaf pine; and scrub saw palmetto and gallberry, together with a growth of wire grass and broom sedge, are found in most places.

Generally speaking, cultivation of this soil has been unsuccessful in Flagler County, although good yields of Irish potatoes, corn, cowpeas, velvet beans, and Rhodes grass have been obtained where a mixture of 2 tons of ground limestone and 1 ton of slaked or burnt lime per acre has been applied to plowed land and thoroughly worked in by harrowing about 1 month previous to planting. In addition to liming, adequate drainage has been provided where the best results have been obtained, and about the same fertilization has been given the various crops as on the Bladen fine sand. Among the best farmers on the St. Johns fine sand it is customary the first year, after breaking to a depth of about 5 inches, to plant corn instead of Irish potatoes, and at the last working to sow cowpeas or velvet beans between the rows. After harvesting the corn, the stalks and the legume vines are cut with a stalk cutter or rolling cutter and plowed under. The second year the land is broken to a depth of about 6 inches and about 2 tons per acre of ground limestone is applied where the hardpan is near the surface. Irish potatoes are grown and succeeded by corn and cowpeas, as on the Bladen fine sand. The third year the same crops are again grown, but the soil is broken to a depth of about 8 inches. The fourth year the field is used for hay, sweet potatoes, or some crop other than Irish potatoes or corn. Irish potatoes have yielded from 30 to 50 barrels per acre, and corn 15 to 35 bushels.

This land is valued at prices ranging from \$5 to \$40 an acre, depending upon the character of the range, the quality of timber, and

the distance from towns and lines of transportation. Improved areas range in price from \$50 to \$125 an acre.

Where there is a distinct loaminess throughout the soil section, excepting of course the hardpan layer, this type can be made fairly productive by such means as artificial drainage, liming, and breaking the hardpan layer, which obstructs the movement of moisture. After a few years of cultivation the organic matter in the surface layer is largely depleted and the color becomes white, like that of the Leon soils, and the necessity of supplying the soil with large amounts of vegetable matter, instead of burning it off, as is often done, is readily apparent. In Bradford County strawberries are grown extensively on the more loamy variation of this type, and in trucking sections it is used successfully for the production of celery, lettuce, beets, and tomatoes. Where the subsoil, except the hardpan layer, is incoherent and flows like quicksand when wet, the type should remain in forest and permanent grazing land.

ST. LUCIE FINE SAND.

To a depth of 36 inches or more the St. Lucie fine sand consists of a loose, incoherent, white to light-gray fine sand. No hardpan is encountered in the 3-foot section, but where the type adjoins the St. Johns fine sand a hardpan layer is usually present at lower depths. In the hammock areas the soil to a depth of 1 to 3 inches is a gray fine sand, carrying a noticeable amount of organic matter.

The St. Lucie fine sand occupies long, narrow ridges parallel with the coast from the northeast corner of the county to the House of Refuge. Other areas occur east of Gore Lake, and in the vicinity of Neoga, southwest of Relay. The type lies higher than the surrounding soils and in places has a hummocky surface. It is excessively drained.

This soil has not been cleared of its native vegetation, which consists principally of evergreen oak, some sand pine, Cuban pine, and cabbage palmetto, together with an undergrowth of saw palmetto, rosemary, oak runner, and a few other plants.

In Putnam County there are some successful citrus groves on this soil, while farther to the south it has been the principal pineapple soil of Florida. It requires large quantities of fertilizer and barnyard manure in order to supply the needed plant food and maintain good moisture conditions.

COQUINA.

The Coquina formation consists of stratified shell fragments, the shell belonging principally to the coquina clam, but supplemented by conch shells and those of the oyster, clam, and other mollusks. Some of the strata consist of finely divided shell fragments and

others of coarse fragments. The strata vary from well-cemented shell rock to loose fragments. The white and brown shells give a speckled appearance to an exposed section. In places a dark-gray to brownish fine sand overlies the coquina. The coquina beds grade into the Coastal beach sands, which are in many places underlain with the former.

Coquina beds occur typically east of Bella Vista, occupying a narrow ridge 200 to 500 feet from the coast and extending parallel with the coast for a distance of about $2\frac{1}{2}$ miles.

The Coquina is nonagricultural, although it supports a growth of cedar and live oak. The value of the coquina material for building purposes has long been recognized. The indurated shell-rock formation was the chief building material used in the early days of St. Augustine. Fort Marion was built of blocks of this material. The loose rock is used with cement in making blocks, which are used in large structures.

PEATY MUCK.

Peaty muck, as mapped in Flagler County, consists of vegetable matter in various stages of decomposition, mingled with varying proportions of mineral matter. The typical Peaty muck beds are made up of black or dark-brown, fibrous to rather finely divided vegetable matter, mixed with a small amount of mineral matter, mainly fine sand. This is usually underlain at any depth from about 12 to 24 inches by a gray, fine sand, but in a few cases by a gray or drab clay. Included with the Peaty muck in places are areas of Peat, where the fibrous vegetable matter is more than 3 feet deep and is almost free from grit.

Peaty muck occurs most extensively in the swamps and marshes along Black and Sweetwater Branches; in Shakey, Hoghouse, and Cross Bays, in Hull Cypress Swamp, and around the north shore of Lake Diston. Small areas are scattered throughout the county.

The type is not farmed, but furnishes some mast for hogs. In most cases it supports a growth of bay, magnolia, gum, oak, ash, maple, myrtle, briars, and vines, but there are some prairie areas, as along Black Branch, where a rank growth of saw grass, needle grass, bunch grass, and dog fennel occurs.

Until drained, the Peaty muck can not be used for agricultural purposes. With proper drainage, and the application of lime to correct the acidity, this soil will be found well adapted to celery, onions, cabbage, tomatoes, and Irish potatoes.

SWAMP.

Swamp includes the flood plains along streams and other low-lying areas that are more or less covered with water throughout the

year, and which in addition comprise such an intermingling of soils that it is almost impossible to separate them into their proper series and types. In many places the surface material is somewhat mucky, while in others, as in the swamp along Sweetwater Branch, a layer of Peaty muck or Peat, from 6 inches to 2 feet in thickness, often overlies a gray, loose fine sand. The material in the flood plains of Haw Creek, Middle Haw Creek, Little Haw Creek, and Sweetwater Branch is often a heavy, dark-gray or black clay, resembling the Bladen clay, while along most of the other streams the flood plains comprise a mixture of soils, including the Bibb fine sand, which is a light-gray fine sand extending to a depth of 3 feet or more; the Ochlockonee fine sand, a brown loamy fine sand; and the Johnson fine sand, a dark-gray fine sand passing into gray or mottled gray and yellow fine sand. In some cases the loams, clay loams, or clays of the Bibb, Ochlockonee, and Johnson series are encountered.¹ There are places where a mucky material or a gray fine sand is underlain by a marly clay.

Extensive areas of Swamp are developed on the east side of Crescent Lake and also a fairly large area along Haw Creek to the southeast of Mud Lake. Other important areas lie along Middle Haw Creek, Sweetwater Branch, Black Branch, and Sparkman Branch, and smaller areas in every part of the county.

The type is considered of no agricultural importance, except for grazing. The tree growth is heavy. Along the streams it consists of bald cypress, pond cypress, black gum, sweet gum, tupelo gum, water oak, willow oak, live oak, laurel oak, Cuban pine, water maple, silver maple, hickory, ash, elm, cabbage palmetto, magnolia, tulip, and persimmon. Pond cypress is the predominating tree in the larger and wetter swamps. Cedar grows where there is a marl subsoil. If the Swamp were well drained some very good soil would be available in places, especially in the heavier areas and those having a marly subsoil.

COASTAL BEACH.

The Coastal beach consists of a gray, incoherent sand ranging in texture from very fine to medium, mixed with varying amounts of broken shells. In the basinlike areas between the ridges and sand dunes the surface material has a dark-gray color, due to a slight admixture of organic matter. Included narrow strips of dark-brown to grayish-brown fine sand contain considerable organic matter, and are underlain by a grayish-brown or speckled grayish and brownish fine sand or "shelly" fine sand. Mixed with the sand in these areas is a large quantity of finely broken shell fragments. Such

¹ These series are not mapped separately in this area, but are widely distributed through the Coastal Plain from North Carolina to the Mississippi River.

areas really represent the Palm Beach sand—a soil mapped in the Indian River area—but owing to their small extent they are combined with the Coastal beach in mapping.

The Coastal beach is confined to a narrow belt which extends back 100 to 600 yards from the shore line. From the water's edge up to the base of the barrier the surface is smooth, but the remainder, and the larger part of the type, is comprised of a series of broken ridges, knolls, and hummocky areas running parallel with the coast. About 2 miles from the northeastern corner of the county the surface is relatively flat, dotted with small accumulations of sand. The Coastal beach everywhere presents evidences of wind action, and in many places a dunelike topography has been developed. On account of its loose and porous structure, the drainage is excessive.

In a few places the type affords some scant grazing, but because of the excessive drainage and the salt spray, which is often carried back for half a mile or more and which is detrimental to the growth of most plants, the Coastal beach has practically no agricultural value. In some places it supports a dense growth of saw palmetto and scrub oak and a scattering of cabbage palmetto. Where the sand is unprotected by vegetation, it is easily moved about by the winds.

TIDAL MARSH.

Tidal marsh comprises low-lying, wet areas subject to salt-water inundations at times of high tide. The soil varies from fine sand to clay, and includes many patches of Peaty muck and Muck.

The principal areas of Tidal marsh occur along the Florida East Coast Canal and along Matanzas River and Bulow Creek. The type is comparatively extensive, but agricultural development, aside from grazing and the cutting of marsh hay, is almost impossible on account of the inundations by salt water and the salty condition of the soil, which precludes the growth of plants other than those of a salt-tolerant character. Salt weed and sword grass are the most characteristic plants. A considerable part of the Tidal marsh could be reclaimed by diking, but this would be very expensive and impracticable under present conditions.

MARSH.

The soil of the Marsh classification ranges from a gray to black fine sand to clay comparable in many places to the Bladen clay. Included with the Marsh are small spots of Peat, Peaty muck, and Muck which could not be separated on the soil map.

Marsh occurs in the western part of the county along Haw Creek, and Crescent Lake. The Marsh is locally known as fresh-water prairie. The soil is wet most of the year and is subject to inundation

by fresh water at times of high water from gales, particularly when the water in St. Johns River is pushed back into Crescent Lake. The type under present conditions has no agricultural value other than for grazing. In the vicinity of Mud Lake the Marsh supports a heavy growth of needle and bunch grasses.

Expensive diking would be necessary to reclaim this marsh land. When it is thoroughly drained and reclaimed there is every reason to believe that large yields of staple crops and grasses may be obtained.

SUMMARY.

Flagler County lies in the northeastern part of Florida, about 50 miles south of Jacksonville. It has an area of 491 square miles, or 314,240 acres.

The surface in general is almost level, broken along the coast and to a lesser degree along streams and around lakes by low ridges. West of the principal divide the streams flow northwest, west, and southwest through Crescent Lake to the St. Johns River, while to the east the drainage is carried eastward and southeastward to the Atlantic Ocean.

Elevations in the county range from almost sea level to 29 feet above. The average for the county is about 24 feet.

Settlement in the region now comprising Flagler County, which began early in the eighteenth century, was at first confined to favorable locations near the coast. During the last 10 years there has been a very rapid increase of population in the western half of the county, due to the development of the potato-growing industry. The settlers in this section have come from all parts of the United States and Canada.

The county is fairly well supplied with transportation facilities, there being two railroads in addition to water transportation by the Florida East Coast Canal and Crescent Lake.

The Dixie Highway, a brick road, passes through the county, and in addition there are a number of shell and graded roads.

The climate of Flagler County is subtropical, being characterized by a long summer season and short, pleasant winter season. The mean annual temperature is about 69.5° F., and the mean annual precipitation is about 50 inches. There is a normal growing season of about 305 days.

The selling price of the better farming land ranges from \$30 to \$150 an acre for unimproved areas and from \$100 to \$300 an acre for improved areas.

Early Irish potatoes are by far the most important crop. Corn, cowpeas, sugar cane, sweet potatoes, and oats, ranking in the order named, are grown rather extensively. Velvet beans, peanuts, sweet

clover, Bermuda grass, Rhodes grass, Sudan grass, Para grass, Johnson grass, and Natal grass, saccharine sorghum, rye, soy beans, snap beans, and lima beans, and milo and kafir are grown to some extent. The growing of citrus fruits and Muscadine and other native grapes receives some attention.

The raising of cattle and hogs on the open range is an important industry. The hogs are being improved by the importation of pure-bred boars and sows.

All the farmers use commercial fertilizer for Irish potatoes. Corn and other crops following the potatoes are not fertilized, but receive benefit from the fertilizer applied to the potatoes.

The soils of Flagler County vary from loose sands to heavy clays and Peaty muck, but they are predominantly fine sands. In topography and drainage they range from shallow, undrained soils of basin areas, through flat, poorly drained areas to excessively drained ridges. On the basis of origin they are classed in four general groups: Soils derived from the sedimentary formations, alluvial soils, cumulose soils, and unclassified soils. The sedimentary soils are classed mainly in the St. Johns, Bladen, Norfolk, Plummer, and Leon series, but include small areas of St. Lucie, Parkwood, Portsmouth, and Gainesville soils. To the alluvial group belongs a large part of the area of the Bladen and Parkwood soils, and most of the Portsmouth and Plummer areas occurring along streams.

The St. Johns fine sand is an extensive soil, but it is used chiefly as range for cattle, less than 3 per cent of its area being under cultivation. Where this soil has been properly ditched, fertilized, and treated with lime it gives good yields of Irish potatoes and corn.

The Bladen fine sand is one of the most extensive and important soils of the area. About 5 per cent of it is cultivated, the remainder being used as open range for cattle and hogs. Irish potatoes, corn, cowpeas, sugar cane, and upland rice do very well. The typical Bladen fine sandy loam is the best Irish-potato soil of the county. About 25 per cent of it is cultivated. The swamp phase of the Bladen fine sandy loam, and the Bladen clay, with its swamp and prairie phases, are not cultivated, on account of the excessive moisture. These soils are used as open range for stock.

The Norfolk soils are well drained and are warm natured, being especially adapted to early truck crops, sweet potatoes, and sugar cane. Corn, cowpeas, and upland rice are also grown. Citrus fruits and Muscadine and other American grapes do very well on these soils. The yields on the hammock phase are about equal to those on the typical Norfolk fine sand. The yields on the shell phase of this type are a little larger and on the scrub phase a little smaller.

The Plummer fine sand and its swamp phase are characterized by light-gray to dull-gray subsoils. They are poorly drained and are not under cultivation, being used solely for grazing.

The Leon fine sand and its scrub phase are well developed in the southern part of the county. They are not cultivated and are considered poor agricultural soils. They need irrigation, the addition of organic matter and lime, and blasting or deep subsoiling to open the hardpan layer of the subsoil.

The St. Lucie fine sand is conspicuous on account of its white color. Because of its lack of organic matter and excessive drainage it is considered of little agricultural value.

The Parkwood soils occur in poorly drained shallow basins or low hammock areas, and have marl or marly-clay subsoils. They are very productive when drained, and are especially adapted to the legumes and corn.

The Portsmouth soils occur in low, flat areas, and are not important agriculturally, although when artificially drained they make good corn and truck soils.

The Gainesville sand has a calcareous subsoil and is underlain with coquina. It occurs on ridges and is well drained and productive.

The Peaty muck is not farmed, but with proper drainage and the application of lime to correct acidity this soil will be found adapted to celery, onions, cabbage, tomatoes, and Irish potatoes.

Coastal beach, Swamp, Tidal marsh, and Coquina represent areas in which the soil material is not sufficiently uniform to be classed with established series. Except for a little gardening these soils are not cultivated, but they are used to some extent for grazing.



[PUBLIC RESOLUTION—No. 9.]

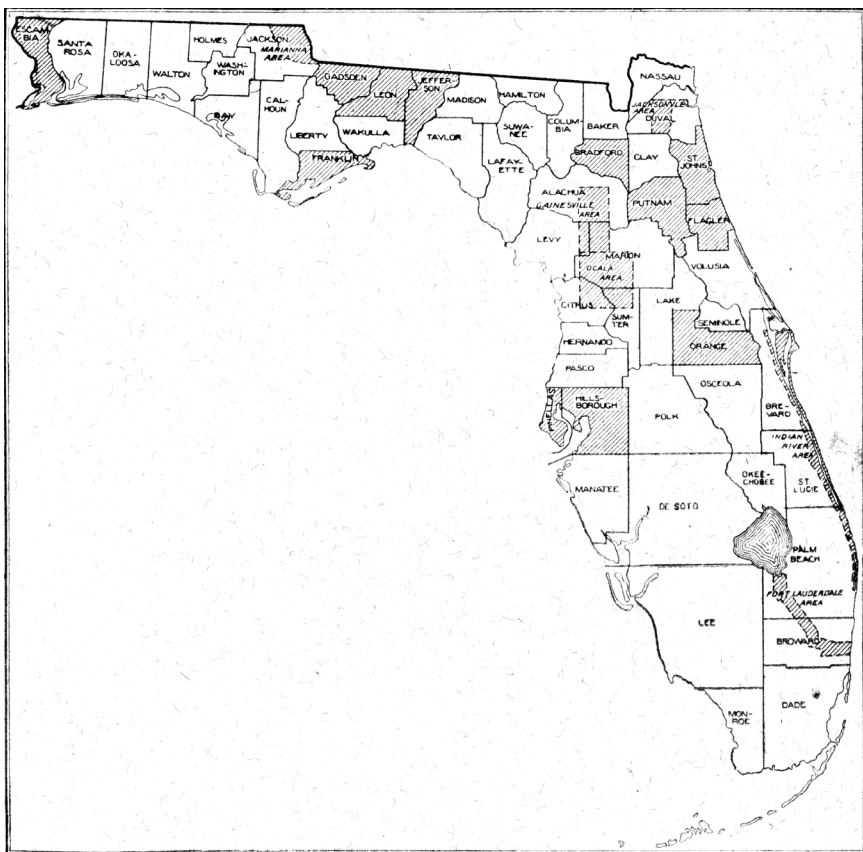
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

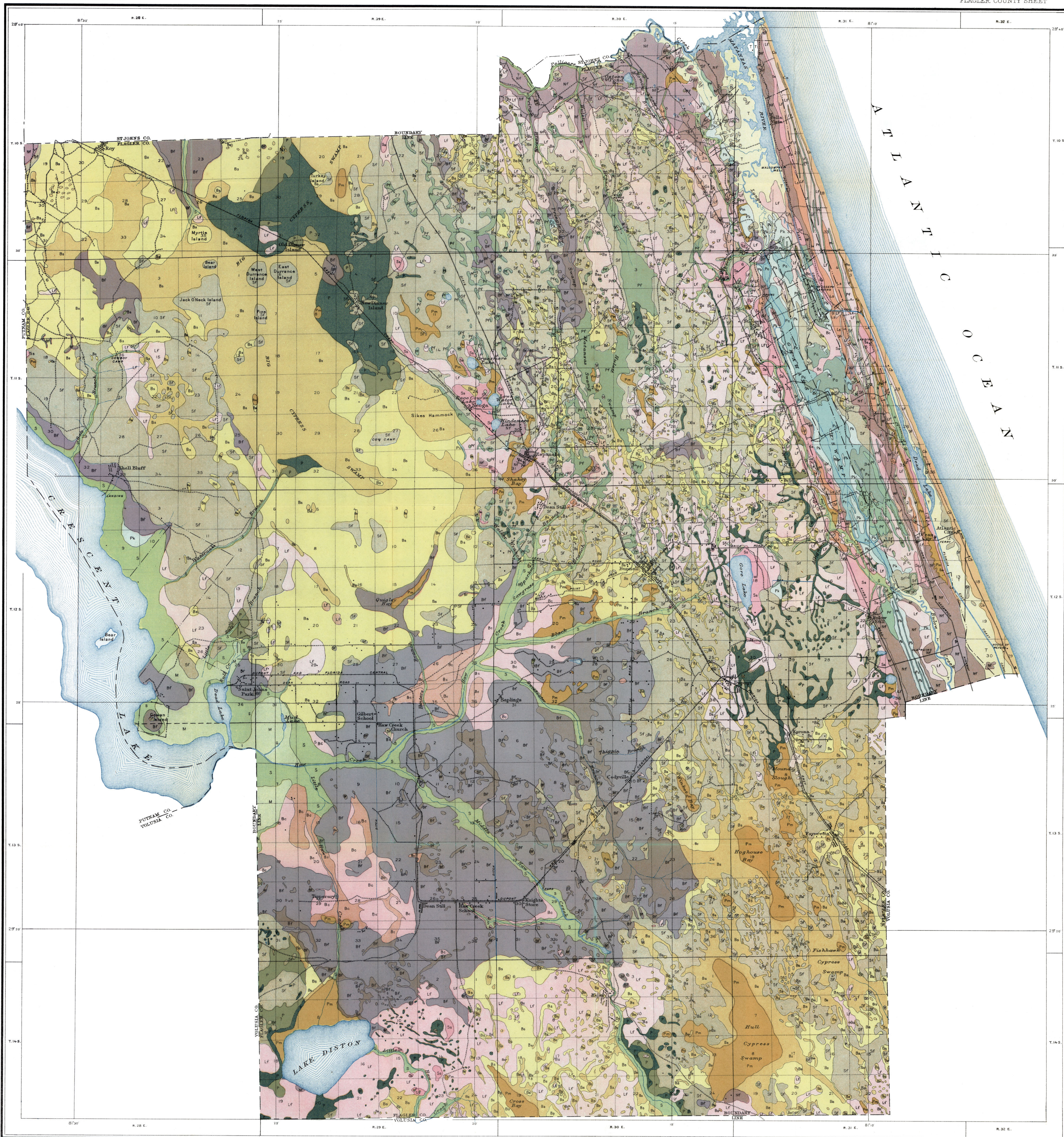


Areas surveyed in Florida, shown by shading.

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LEGEND	
Bladen fine sand Bs	Parkwood fine sandy loam Pk
Swamp phase Bladen fine sandy loam Bf	Parkwood clay Pc
Swamp phase Bladen clay Bc	Prairie phase Plummer fine sand Pf
Swamp phase Bladen fine sand Bc	Swamp phase Fortmouth fine sand Pf
Prairie phase Gainesville sand G	Swamp phase St. Johns fine sand Sf
Lakewood fine sand Ls	St. Lucie fine sand Sl
Leon fine sand Lf	Coastal beach Cb
Scrub phase Norfolk fine sand Nf	Coquina Co
Scrub phase Norfolk fine sand Nf	Marsh M
Scrub phase Norfolk fine sand Nf	Peaty muck Pm
Hammock phase Norfolk fine sand Nf	Swamp S
Shell phase Norfolk fine sand Nf	Tidal marsh T

CONVENTIONAL SIGNS	
CULTURE (Printed in black)	
City or Village, Roads, Buildings, Wharves, Jetties, Breakwaters, Leaves, Light-house, Text	Railroads and Electric R.R. crossings, Tunnel School or Church Cemeteries
Secondary roads and trails	Buff Encampment, Rock outcrop, and Transposition station
Bridge, Ferry	Soil boundaries
Ford, Dam	State boundary County boundary City or Village Cemeteries
Mine or Quarry Mine dumps Made land	Swamp Soil boundaries
Shrub and Gravelly areas	Swamp Soil boundaries
Boundary lines	Swamp Soil boundaries
Boundary lines	Swamp Soil boundaries
Boundary lines	Swamp Soil boundaries
RELIEF (Printed in brown or black)	
Contours Depression contours	Pointed Hills Mountain Peaks
Small Washland Sand dunes	Shore and Low water line: Swallow
DRAINAGE (Printed in blue)	
Streams	Lakes, Ponds, Intermittent lakes
Intermittent streams	Springs, Canals and Ditches, Flumes
Swamp Soil boundaries	Submerged marsh Tidal flats